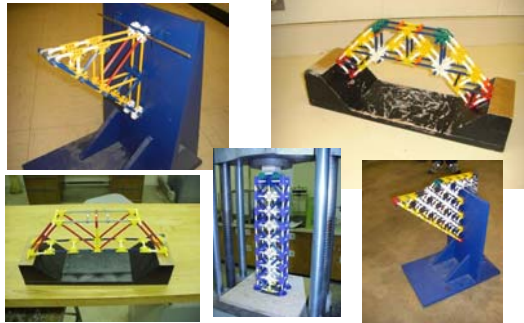


## Project #1 – K'NEX Truss

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## Project #1 – K'NEX Truss

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- The objective is to design, analyze, and construction a truss structure using K'NEX connectors and rods with that supports the design loads.
- All structures must hold the design load. Once the design load is sustained, structures with be evaluated based on the largest cost-adjusted strength-to-weight (*SWR*).



## Project #1 – K'NEX Truss

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### Design Report

- A written report is required for each K'NEX structure submitted for evaluation.
- The content and quality of the report will account for 50% of the project score.
- The remaining 50% of the project grade will be determined by the strength of the structure based on the ultimate strength-to-weight ratio (*SWR*).

## Project #1 – K'NEX Truss

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### Design Report

- There are two strength criteria for structures:
  1. all structures must support the design - 60 pound minimum (30% all-or-nothing -- structures supporting 60 pounds or more receive 30 points; structures that do not support the load receive no points; and
  2. the structure with the highest *SWR* is awarded full points (20%) and the remaining structures will be awarded scores commiserate with their performance (first place will be awarded 20 points, second place 19 points, third place 18 points, etc. . .).
- If a structure does not meet the construction rules, listed below, the submitting student will receive no strength points.

## Project #1 – K'NEX Truss

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### Design Report

The design report should include, but not limited to the following:

- **Title page** - name, date and course information
- **Introduction** - design and report requirements
- **Structural Design** - a complete set of plans for the structure
- **Structure Analysis** - a complete design and analysis of the structure including the force in each member for the applied load. Assume the modulus of elasticity of the K'NEX plastic is 377 *ksi*. Also, include a prediction of the ultimate load of your structure. Show evidence that you refined and optimized your structure during the design process.
- **Summary** - summarize the strengths and weaknesses of your design and give a prediction for the ultimate load and *SWR*.

## Project #1 – K'NEX Truss

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### Construction Rules

1. Structures must be constructed using only K'NEX pieces.
2. Glue is not allowed in construction of the structure.
3. K'NEX members cannot be coated or treated in any way.
4. The structure must be designed to fit on the support shown in Figure 1.

### Project #1 – K'NEX Truss

#### Construction Rules

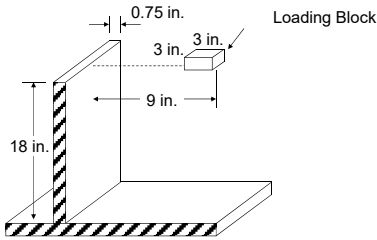
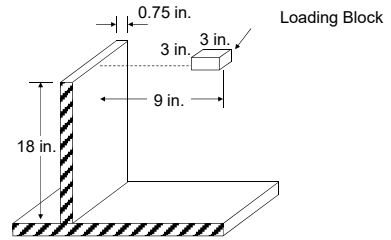


Figure 1. K'NEX structure loading scenario and dimensions

### Project #1 – K'NEX Truss

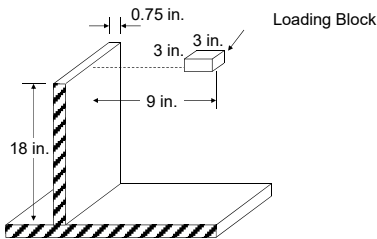
#### Construction Rules



- The structure must cantilever at least 9 inches from the support. The height of the structure must not exceed 14 inches.

### Project #1 – K'NEX Truss

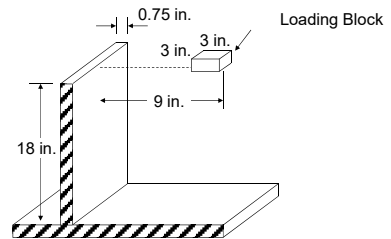
#### Construction Rules



- The height of the structure will be determined from the lowest point on the support to the highest point on the structure.

### Project #1 – K'NEX Truss

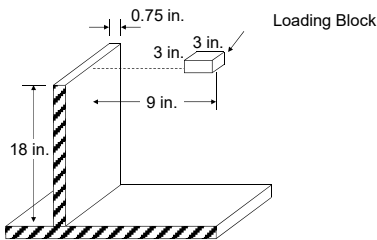
#### Construction Rules



- The structure must be a minimum of 2 inches wide.

### Project #1 – K'NEX Truss

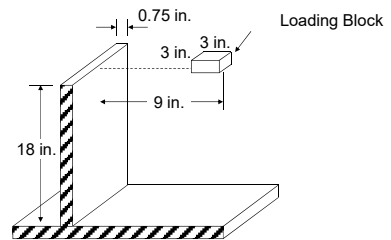
#### Construction Rules



- A tolerance of 1/8 inches will be granted on all envelope dimensions.

### Project #1 – K'NEX Truss

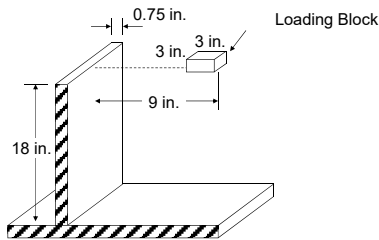
#### Construction Rules



- The cantilever structure must include a connection to the support.

## Project #1 – K'NEX Truss

### Construction Rules



6. In other words, your cantilever structure should connect to the vertical support wall.

## Project #1 – K'NEX Truss

### Construction Rules



6. In other words, your cantilever structure should connect to the vertical support wall.

## Project #1 – K'NEX Truss

### Construction Rules



6. In other words, your cantilever structure should connect to the vertical support wall.

## Project #1 – K'NEX Truss

### Construction Rules

- All structures will be loaded via a 3 in. by 3 in. loading block (see Figure 1) to the design load of 60 lb. or to the point of failure which occurs first. Failure is defined as the point when the structure can no longer support an increased load or collapse.
- Each student may submit only one structure.
- Structural performance will be measured by a strength-to-weight ratio computed in the following manner:

$$SWR = \frac{P}{W_{structure}}$$

where  $SWR$  is the strength-to-weight ratio,  $P$  is the ultimate load (lb.), and  $W_{structure}$  is the weight of the structure (lb.).

## Project #1 – K'NEX Truss

### Construction Rules

- The cost of each structure will be estimated using the following cost sheet. A cost factor will be computed as follows:

$$Cost\ Factor = \frac{Maximum\ Bridge\ Cost}{Your\ Bridge\ Cost}$$

- An adjusted  $SWR$  computed as follows:

$$SWR_{Adjusted} = Cost\ Factor \times SWR$$

- The structure with the highest  $SWR$  ratio will win the event.
- Any modifications or repairs to the structure must be done before registration. Once the structure is registered, no other changes may be made.

## Project #1 – K'NEX Truss

### Construction Rules

Connectors	Part	Cost/Part	Rods	Part	Cost/Part
	Tan Clip	\$10		Green	\$10
	Purple	\$10		White	\$20
	Light Gray	\$15		Blue	\$40
	Orange	\$20		Yellow	\$60
	Red	\$30		Red	\$80
	Dark Gray	\$40		Tan	\$80
	Green	\$50		Light Gray	\$100
	Yellow	\$50			
	Blue	\$70			
	White	\$90			

## Project #1 – K'NEX Truss

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### Construction Rules

Connectors	Part	Weight/Part (g)	Rods	Part	Weight/Part (g)
	Tan Clip			Green	0.46
	Purple			White	0.78
	Light Gray	0.85		Blue	1.31
	Orange	1.45		Yellow	2.02
	Red	1.69		Red	3.02
	Dark Gray	2.17		Tan	3.11
	Green	2.10		Light Gray	4.48
	Blue	3.25			
	Yellow	2.51			
	White	3.57			

## Project #1 – K'NEX Truss

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### Schedule

Date	Event
January 31, 2019	Rules and Instructions
February 22, 2019	Prototype Testing (out of class time)
February 28, 2019	Final Testing and Design Report

## End of K'NEX Truss Project

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Any questions?

